Return to Work After Primary Rotator Cuff Repair

CME

A Systematic Review and Meta-analysis

Eric D. Haunschild,* BS, Ron Gilat,* MD, Ophelie Lavoie-Gagne,* MD, Michael C. Fu,* MD, Tracy Tauro,* BS, BA, Brian Forsythe,* MD, and Brian J. Cole,*† MD, MBA
Investigation performed at Midwest Orthopaedics at Rush, Rush University Medical Center, Chicago, Illinois, USA

Background: Rotator cuff tears are a prevalent pathology in injured workers, causing significant economic ramifications and time away from work. To date, published articles on work outcomes after rotator cuff repair have not been cumulatively assessed and analyzed.

Purpose: To systematically review reports on return to work after rotator cuff repair and perform a meta-analysis on factors associated with improved work outcomes.

Study Design: Systematic review and meta-analysis; Level of evidence, 4.

Methods: A systematic review of return-to-work investigations was performed using PubMed, Embase, and the Cochrane Database of Systematic Reviews in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Individual studies reporting rates of return to previous work with level of evidence 1 to 4 were independently screened by 2 authors for inclusion, and study quality was assessed using the Methodologic Index for Non-randomized Studies and Newcastle-Ottawa Scale. Work outcome data were synthesized and analyzed using random effects modeling to identify differences in rates of return to previous work as a function of operative technique, work intensity, and workers' compensation status.

Results: Thirteen retrospective investigations comprising 1224 patients who underwent rotator cuff repair met inclusion criteria for this investigation. Across all investigations, a weighted average of 62.3% of patients returned to previous level of work at 8.15 ± 2.7 months (mean ± SD) after surgery. Based on random effects modeling, higher rates of return to previous work were identified with decreasing work intensity ($P < .001$), while rates were similar between open and arthroscopic repair technique ($P = .418$) and between workers' compensation and non–workers' compensation cohorts ($P = .089$). All shoulder pain and functional outcome assessments demonstrated significant improvements at final follow-up when compared with baseline across all investigations.

Conclusion: The majority of injured workers undergoing rotator cuff repair return to previous work at approximately 8 months after surgery. Despite this, >35% of patients are unable to return to their previous work level after their repair procedure. Similar rates of return to work can be anticipated regardless of workers' compensation status and operative technique, while patients in occupations with higher physical intensity experience inferior work outcomes.

Keywords: rotator cuff repair; return to work; workers' compensation; shoulder

Rotator cuff injury is a significant and increasingly prevalent pathology seen in orthopaedic clinics, resulting in >250,000 rotator cuff repairs performed each year in the United States.[12,25] It is estimated that more than two-thirds of repairs are performed in working-age patients and are directly related to significant disability and time away from work, particularly in patients in labor-intensive occupations.[25] As our population ages, this proportion of injured workers is expected to increase because of the higher incidence of rotator cuff pathology with age and an increasing number of adults expecting to work beyond retirement age.[37,38]

There have been many studies focusing on work outcomes after rotator cuff repairs, given their high prevalence and significant economic repercussions. However, each investigation has been limited by small heterogeneous worker populations and differing operative techniques, limiting the generalizability of each to the diverse array of patients experiencing rotator cuff injury. Additionally, there have been few to no previous efforts to cumulatively assess return-to-work outcomes across individual studies.

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The purpose of this investigation is to systematically review the literature on rates of return to previous work after open and arthroscopic rotator cuff repair and to identify factors associated with higher rates of return to work. We hypothesized that workers undergoing rotator cuff repairs would have high rates of return to work and that operative technique, job type, and workers' compensation status would be significant factors in achieving return to previous work level.

METHODS

Search Strategy

The systematic review and meta-analysis were performed in accordance with the 2009 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement.[27] First, a systematic review of investigations reporting return-to-work outcomes of rotator cuff repair surgery was conducted with a published literature search in PubMed, Embase, and the Cochrane Database of Systematic Reviews. Reference lists of all included studies were reviewed to identify additional pertinent studies not identified in the original search. The search strategy was performed by combining the following keywords: (1) "rotator cuff repair" OR "cuff" and (2) "return-to-work." All searches were performed in February 2020. Review registration was completed in February 2020 using the PROSPERO International Prospective Register of Systematic Reviews (171544).

Study Selection and Data Extraction

This study included all clinical investigations meeting the following inclusion criteria: documentation of rates of return to previous work, level of evidence 1 to 4, and article written in the English language. All review articles, expert opinions, studies that did not define successful return to previous work activity, and research on nonoperative measures after rotator cuff tear were excluded. The investigations were independently assessed by 2 study authors (E.D.H., R.G.) for inclusion and exclusion criteria, and all search disagreements were resolved through mutual discussion. When available, the following data were collected on an electronic spreadsheet for analysis: number of participants, cohort age, cohort sex, dominant shoulder involvement, repair technique, workers' compensation status, preoperative type of work, postoperative type of work, number of patients successfully returning to previous level of work, and average time between surgery and successful return to work.

Of note, the definition and scale used to describe work intensity level varied among the included investigations. To perform an analysis based on activity level, studies were pooled by general activity level (as in combining those reporting "sedentary" workers with "light" workers) at the discretion of the senior author (B.J.C.).

Study Quality and Risk-of-Bias Assessment

As all identified studies were nonrandomized, study quality was assessed with the Methodologic Index for Non-randomized Studies (MINORS) and the Newcastle-Ottawa Scale (NOS).[35,36] The MINORS consists of a 12-item checklist of methodologic quality, with possible scores of 0 (not reported), 1 (reported but inadequate), and 2 (reported and adequate). NOS similarly assesses quality using 8 items, with a maximum of 9 points available in the highest-quality studies. Each investigation was independently scored by 2 authors (E.D.H., R.G.) with disagreements resolved by consensus.

Statistical Analysis

Statistical analysis for this investigation was completed using the metaphor package in R (Version 3.6.2; R Foundation). Baseline patient characteristics were evaluated and reported using weighted means and standard deviations. Upon preliminary review, studies were expected to have high heterogeneity attributed to differing patient populations, operative techniques, and definitions of primary outcomes. Thus, we used the DerSimonian-Laird method to calculate pooled effect sizes.[7-9] Heterogeneity was evaluated with I^2 values, and all pooled statistics were reported with 95% CIs. All binary outcomes in this review were assessed using a random effect meta-analysis of proportions to determine difference in work outcomes as a function of workers' compensation status, work intensity level, and operative technique. To evaluate the effect of modern repair techniques on work outcomes, a subanalysis of publications published in the previous 5 and 10 years was performed and compared with the results of earlier studies. Forest plots were then used to summarize the findings of all meta-analyses. Significance was determined as P values $<.05$.

RESULTS

PRISMA Search Process and Results

The initial search produced 271 citations, which (with duplicates removed) resulted in 181 distinct publications

†Address correspondence to Brian J Cole, MD, MBA, Midwest Orthopaedics at Rush, Rush University Medical Center, 1611 W Harrison St, Chicago, IL 60612, USA (email: bcole@rushortho.com).

*Midwest Orthopaedics at Rush, Rush University Medical Center, Chicago, Illinois, USA.

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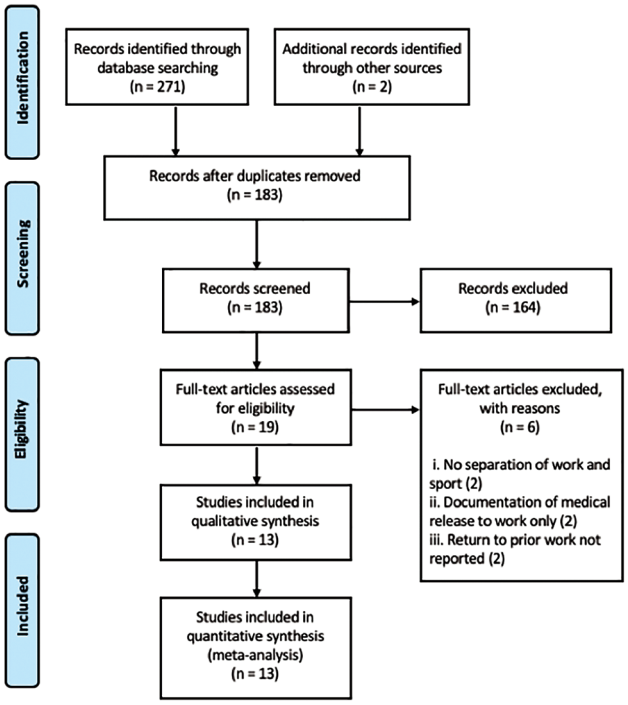

Figure 1. Search results for this investigation in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement.

for title and abstract review. After title and abstract screening, 17 full texts were reviewed for inclusion criteria. Of these, 2 were excluded as they did not separate return to work and return to sports activity[5,16]; 2 reported only medical release to work[10,33]; and 2 were excluded as they did not report rates of return to previous work.[31,34] Two additional investigations[17,26] found outside the initial search met inclusion criteria and were included in analysis. In total, 13 studies were included in this review.[‡] All studies were retrospectively performed, consisting of 7 level 4 studies,[1,3,6,14,17,22,29] 5 level 3 studies,[11,13,26,30,32] and 1 level 2 study.[2] This search strategy is summarized in Figure 1.

Patient Characteristics and Quality Assessment of Included Investigations

Collectively, this review includes 1224 patients aged 52.2 ± 4.9 years (mean ± SD). Return to previous work occurred at 8.15 ± 2.7 months after surgery among all reporting investigations. Overall, 762 (62.3%) of patients were able to return to previous work across all studies. Quality assessment of the included studies varied significantly (MINORS, 4-18; NOS, 4-7). Additional patient characteristics and quality assessment scores are presented in Tables 1 and 2.

Seven studies[3,11,13,17,22,26,29] reported rates of return to previous work as a function of work intensity level. In total, 215 patients were classified as performing work of light intensity; 172, moderate intensity; and 349, high intensity. Return-to-work rates were found to be significantly lower as work intensity increased (94% for light work, 75% for moderate work, and 63% for heavy work; $P < .001$). Random effects modeling and forest plots of outcome by work activity level are presented in Figure 2.

Return to Work by Operative Technique

Eleven of the 13 investigations[§] provided adequate information to assess return-to-work rates as a function of open or arthroscopic surgical technique. This analysis consisted of 599 arthroscopic repairs and 258 open repairs. Among these patients, there were no significant differences in rates of return to previous work in either cohort ($P = .418$). The results of this random effects model are presented in Figure 3.

Return to Work by Workers' Compensation Status

Workers' compensation return-to-work data were available in 4 investigations.[3,17,26,32] It was found that the workers' compensation group had lower return-to-work rates (50.9%) than the non–workers' compensation group (86%), but the difference only approached significance ($P = .089$). In addition, Gowd et al[13] and Hawkins et al[14] reported conflicting results, with Gowd et al finding no difference in outcomes between 79 workers' compensation cases and controls, while Hawkins et al noted significantly worse outcomes in their 8 workers' compensation cases. Owing to insufficient detail in work outcome reporting, these 2 studies were not included in meta-analysis. Random effects modeling and forest plots of workers' compensation outcomes are presented in Figure 4.

Return to Work by Date of Publication

A subanalysis of rates of return to previous work as a measure of publication date was performed on all investigations. When return-to-work rates of studies published before and after 2015 (Figure 5) and 2010 (Figure 6) were compared, there were no significant differences identified ($P = .41$ and $P = .67$, respectively).

Patient-Reported Outcome Measures

Eight investigations[2,6,13,17,22,26,30,32] reported pre- and postoperative pain or functional outcome assessments in their patient cohorts. In all studies, each functional outcome measure significantly improved between preoperative and follow-up assessments. Outcome assessments and recorded values are presented in Table 3.

[‡]References 1-3, 6, 11, 13, 14, 17, 22, 26, 29, 30, 32.

[§]References 1-3, 6, 13, 14, 17, 22, 26, 30, 32.

TABLE 1
Included Study Characteristics and Quality Assessment Evaluation[a]

First Author	Year	Study Design	LOE	MINORS	NOS
Aagaard[1]	2020	Case series	4	13	6
Baysal[2]	2005	Cohort study	2	8	5
Bhatia[3]	2010	Case series	4	8	4
Didden[11]	2010	Cohort study	3	7	5
Gowd[13]	2019	Cohort study	3	7	5
Hawkins[14]	1999	Case series	4	10	6
Denard[6]	2015	Case series	4	9	6
Lin[22]	2012	Case series	4	6	5
Nové-Josserand[29]	2011	Case series	4	4	5
Noyes[30]	2019	Cohort study	3	11	7
Razmjou[32]	2017	Cohort study	3	18	7
Imai[17]	2019	Case series	4	7	6
Misamore[26]	1995	Cohort study	3	11	7

[a]LOE, level of evidence; MINORS, Methodologic Index for Non-randomized Studies; NOS, Newcastle-Ottawa Scale.

TABLE 2
Patient Characteristics of the Included Investigations[a]

First Author	Patients	Age, y[b]	Male: Female	Dominant Arm, Yes:No	WC	Work Intensity	Minimum Follow-up, mo
Aagaard[1]	32	58 (42-70)	25:7	22:10	12	9 light, 4 medium, 19 heavy	12
Baysal[2]	84[c]	55.5 ± 9.3	61:23		13		12
Bhatia[3]	78	54.9 ± 8.2 (35.8-73.2)	61:17	53:25	78	0 sedentary, 17 light, 13 medium, 40 heavy, 8 very heavy	12
Didden[11]	73	49 (36-55)	37:36		9[d]	9 sedentary, 25 light, 18 medium, 21 heavy	
Gowd[13]	89	52.1 ± 8.8			79	3 sedentary, 25 light, 31 moderate, 30 heavy	12
Hawkins[14]	19	33.4 (23-40)	17:2	10:9	8		24
Denard[6]	56	62.6 ± 9.0	45:11				12
Lin[22]	68	42.3 (26-49)	47:21	45:27		55 sedentary, 13 laborers	18
Nové-Josserand[29]	254	50.5 ± 6.4	183:71			16 nonmanual, 67 manual, 179 heavy manual	24
Noyes[30]	35						24
Razmjou[32]	286	52.0 ± 8, 52.0 ± 9[e]	200:86	176:110	246	173 light, 110 heavy	6
Imai[17]	63	60.3 ± 9.0	48:15	36:27	17	24 light, 39 heavy	12
Misamore[26]	103	48 (22-67), 53 (30-68)[e]	74:29		24	41 nonmanual, 30 moderate, 32 strenuous	24

[a]Blank cells indicate *not recorded*. Values are presented as No. unless indicated otherwise. WC, workers' compensation.
[b]Mean ± SD (range).
[c]68 workers.
[d]Owing to the 3 levels of workers' compensation utilized by Didden et al, this cohort was excluded from workers' compensation meta-analysis.
[e]Groups 1 and 2.

Complications and Revision Procedures

Seven investigations[3,6,11,13,14,22,30] reported on complications or revision procedures in their study cohorts. In total, 19 complications or repeat interventions (4.5%) were reported among the 418 combined rotator cuff repairs. Two patients had nerve injury at the time of surgery (1 managed nonoperatively and 1 with unspecified follow-up), and 2 patients developed frozen shoulders during postoperative rehabilitation, with follow-up management unspecified. Two patients underwent manipulation under anesthesia for postoperative stiffness, while another underwent lysis of adhesions, acromioplasty, and distal clavicle excision after developing postoperative stiffness. In addition, 1 patient experienced a 30° loss in forward flexion during a motor vehicle accident at 12 months after index repair and opted for nonoperative management.

Nine (2.1%) revision repairs were reported. Two were required after development of postoperative infections: 1 patient developed an infected subacromial bursitis 5 months after receiving an arthroscopic repair, and 1 had a surgical site infection requiring debridement and

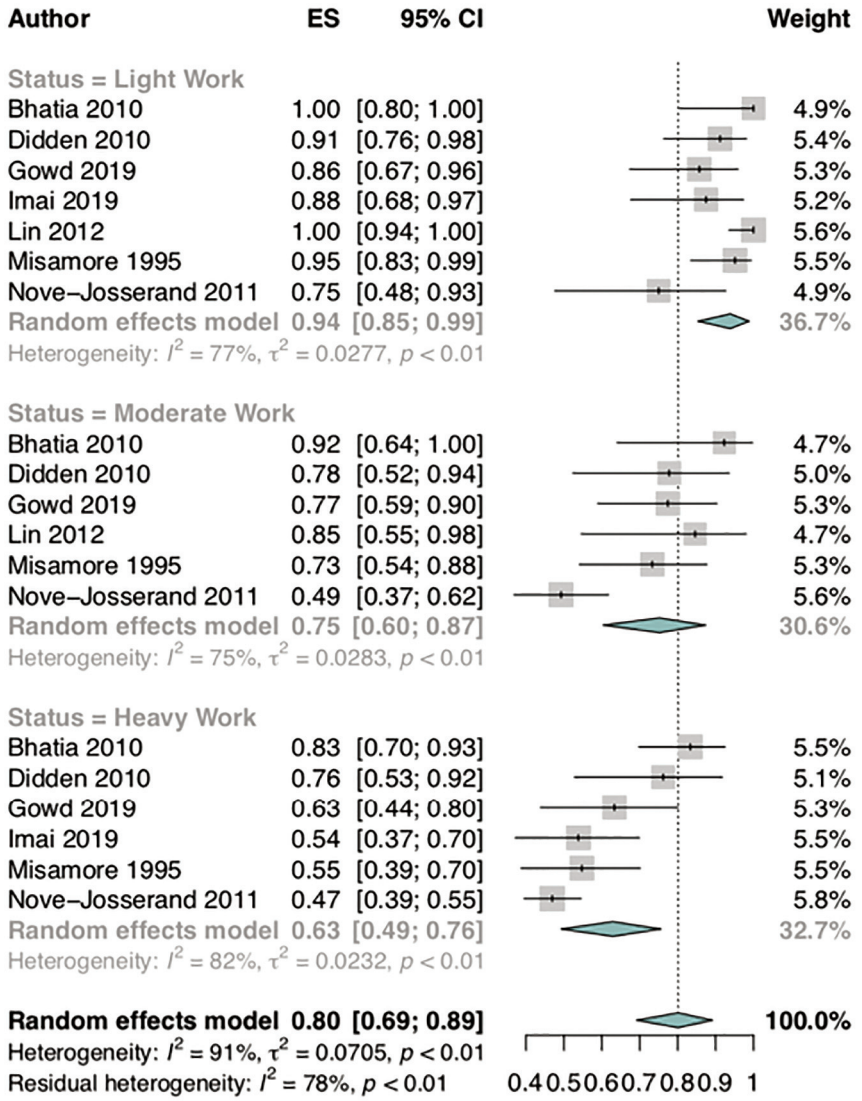

Figure 2. Random effects model of rates of return to previous work as a function of work intensity. ES, effect size.

revision repair. Of the remaining 7 patients, 3 had traumatic tears requiring revision repair; 2 received revision repair secondary to reduced range of motion with radiographic evidence of cuff tear; and 2 underwent revision repairs for unspecified etiology. One additional patient underwent subsequent revision total shoulder arthoplasty after failed repair. The final complication reported was persistent pain after an open repair, for which the patient underwent arthrodesis for symptomatic relief.

DISCUSSION

The primary finding of this review was that the majority of patients undergoing rotator cuff repairs can expect to return to previous work by approximately 8 months after surgery. Rates of return to previous work were comparable regardless of operative technique, while workers in more labor-intensive fields returned to previous work at significantly lower rates than those in sedentary occupations. Workers' compensation cases, while trending toward inferior return-to-work rates, were insignificantly different in outcome as compared with non–workers' compensation cases. These conclusions support those previously reported in individual investigations and can aid in the counseling of injured workers with rotator cuff tears.

The relationship between workers' compensation status and functional outcome in rotator cuff repairs has been clearly defined in previous studies. In general, patients with workers' compensation receive significant improvements in validated outcome measures after repair but to a lesser extent than those without workers' compensation.[15,20,21] Interestingly and in congruence with the conclusions of Gowd et al[13]—whose results were not included in the random effects modeling because of insufficient data reporting—this work found no significant

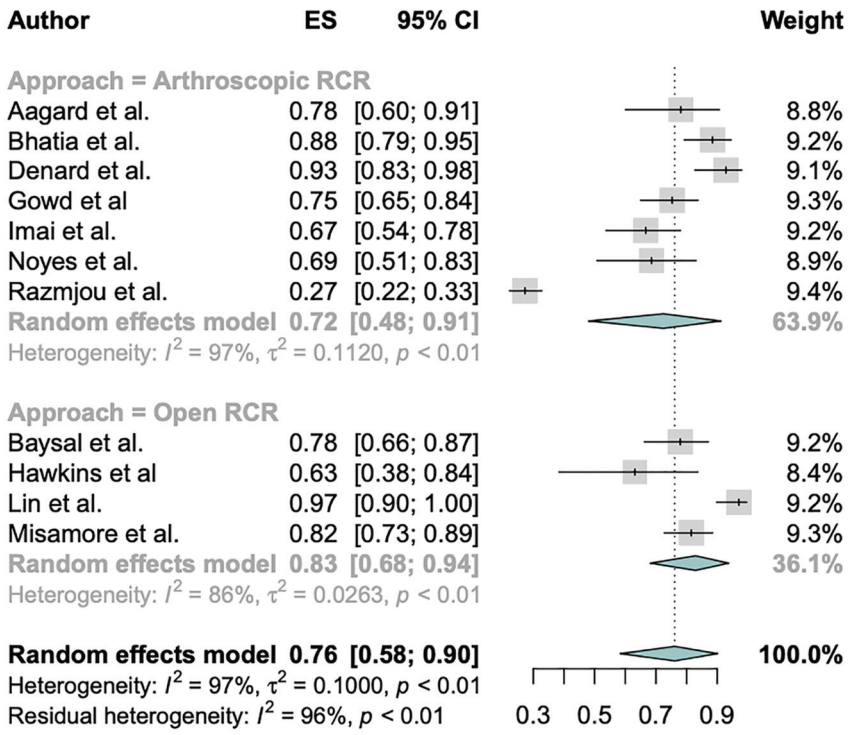

Figure 3. Random effects model of return to previous work levels after arthroscopic and open repair techniques. ES, effect size; RCR, rotator cuff repair.

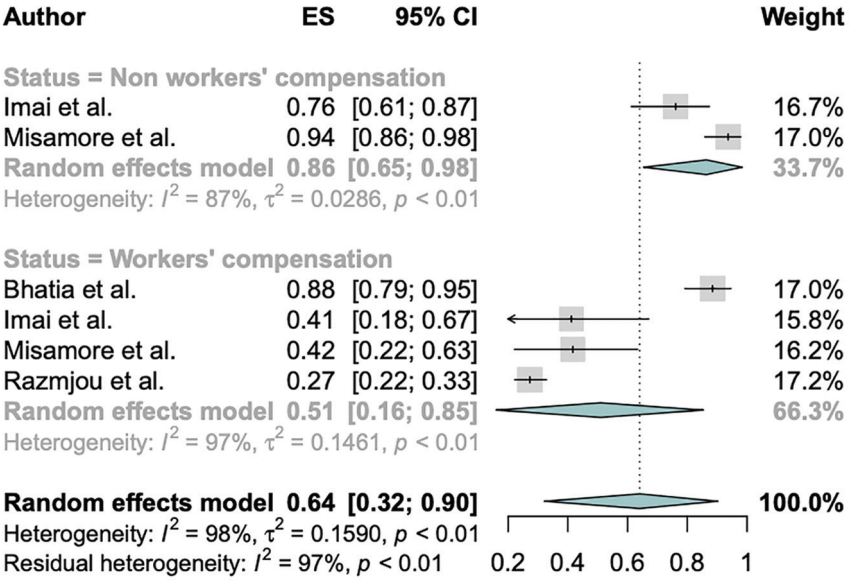

Figure 4. Random effects model for rates of return to previous work among workers' compensation and non–workers' compensation cohorts. ES, effect size.

difference in work outcomes between workers' compensation cases and non–workers' compensation controls. It should be noted that the individual effect size and reported results of the study by Bhatia et al[3] were outliers in this review. This report was included in analysis for completeness, as it met all inclusion and exclusion criteria; otherwise, all other investigations trended to significantly worse work outcomes in workers' compensation cases. Regardless, the findings of this analysis suggest that while workers' compensation cases do have an overall lower

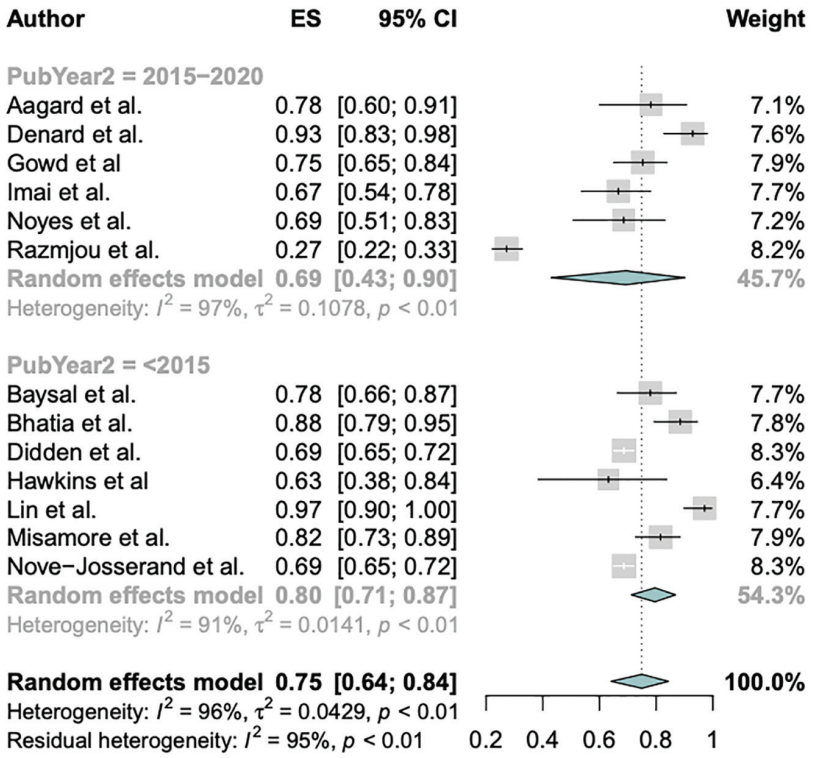

Figure 5. Random effects model for rates of return to previous work before and after a publication date of 2015. There was no significant difference in work outcomes identified. ES, effect size.

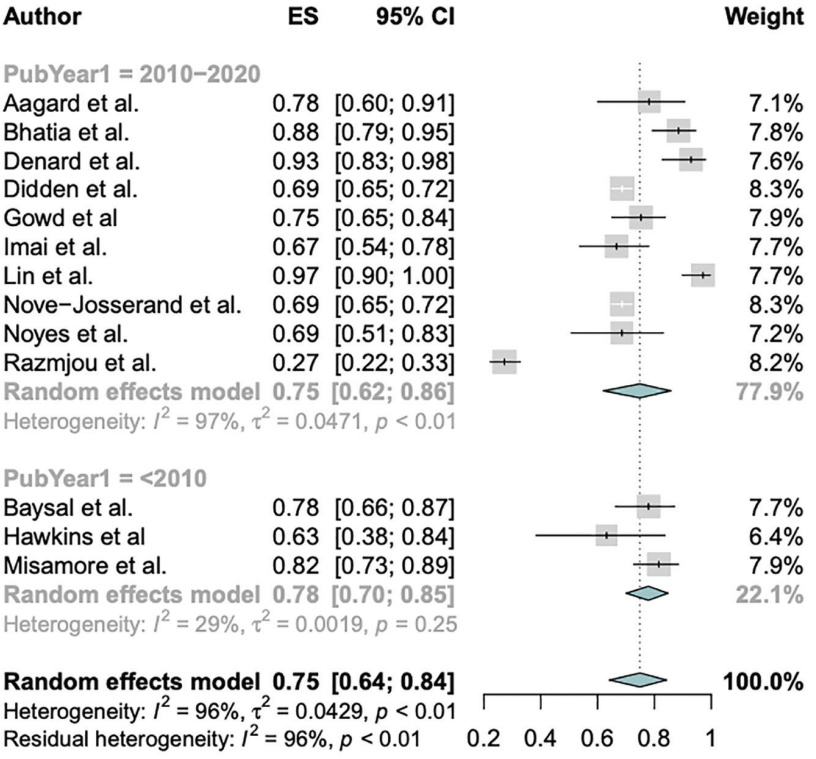

Figure 6. Random effects model for rates of return to previous work before and after a publication date of 2010. There was no significant difference in work outcomes identified in the older and newer studies. ES, effect size.

TABLE 3
Pre- and Postoperative Shoulder Pain and Functional Outcome Reporting Among All Investigations[a]

	Outcome Scores, Mean ± SD			
First Author	Preoperative		Final Follow-up	
Baysal[2]				
ASES	55.4 ± 19.8		91.3 ± 12.4	
WORC	41.6 ± 18.8		86.9 ± 16.7	
Bhatia[3]				
ASES			82.3 ± 20.9	
SANE			83.6 ± 18.4	
Constant			72.2 ± 19.6	
SST			9.5 ± 3.4	
VAS			1.7 ± 2.3	
Gowd[13]				
ASES	40.0 ± 17.1		78 ± 21.5	
SANE	31.3 ± 21.3		66.4 ± 30.7	
Constant	11.0 ± 5.5		22.3 ± 8.7	
Denard[6]				
ASES	36.8 ± 16.7		87.5 ± 11.1	
SST	2.8 ± 2.0		10.1 ± 2.2	
VAS	5.7 ± 2.0		1.1 ± 1.8	
Lin[22]				
VAS	6.0		2.4	
UCLA			32.6	
Imai[17]: JOA	67.4 ± 11.6		85.7 ± 8.9	
	Group 1	Group 2	Group 1	Group 2
Noyes[30,b]				
ASES	40.8	40.6	89.5	78.2
SST	3.8	3.4	10.3	8.6
SANE	32.8	32.4	83.1	76.4
VAS	4.8	5.6	0.8	1.9
Razmjou[32,b]: ASES	33 ± 15	35 ± 19	69 ± 20	54 ± 26
Misamore[26,b]: UCLA	13.7	15.8	26.1	31.5

[a]Blank cells indicate *not recorded*. ASES, American Shoulder and Elbow Surgeons; JOA, Japanese Orthopaedic Association; SANE, Single Assessment Numeric Evaluation; SST, Simple Shoulder Test; UCLA, University of California, Los Angeles; VAS, visual analog scale; WORC, Western Ontario Rotator Cuff Index.

[b]Misamore et al, Noyes et al, and Razmjou et al compared outcomes as a function of factors not relevant to this analysis. As all patients in these cohorts met inclusion for review, the reported scores of all study cohorts were recorded.

incidence of returning to previous work level, the discrepancy in work outcomes may be less than what has been observed with regard to pain and functional outcome assessments.

While long considered the gold standard for rotator cuff repairs, open repair techniques have in recent years been largely replaced by arthroscopic techniques.[19] As arthroscopic techniques have become widely utilized, studies have shown equivalent outcomes in arthroscopic repairs, with significantly fewer complications and a more rapid recovery of function.[4,19,23] The results of this meta-analysis, demonstrating similar return-to-work rates with open and arthroscopic techniques, support the widespread adoption of arthroscopic repairs. Notably, there was insufficient reporting in the included studies to directly compare differences in time away from work using different techniques. Nové-Josserand et al[29] did report on this topic, finding that patients undergoing open rotator cuff repairs returned to work at a mean 10.9 months, as opposed to a nonsignificantly different 8.75 months for those undergoing arthroscopic repairs. Given the return-to-work intervals after arthroscopic repairs reported by Aagaard et al,[1] Bhatia et al,[3] and Gowd et al[13] (range, 5.0-7.6 months), as well as a 72% functional outcome recovery rate by 6 months after arthroscopic repair noted by Manaka et al,[24] it follows that arthroscopic repairs provide comparable return-to-work rates at faster intervals when compared with open techniques.

It is intuitive and not surprising that workers in higher-intensity occupations have lower return-to-work rates when compared with sedentary workers. In addition to the individually reported poorer work outcomes in manual laborers among the included articles, manual laborers have been identified as having worse outcomes after nonoperative interventions and after failure of primary rotator cuff repairs.[18,28] Owing to the potential for overuse after repair and the higher overall incidence of rotator cuff pathology in manual laborers, these patients should be

counseled of the high risk of clinical failure and poorer outcomes when considering operative management of rotator cuff tears.[38]

Several limitations to the current work should be considered when interpreting its conclusions. A significant limitation is the low level of evidence and high heterogeneity among the included studies. The included return-to-work investigations were all retrospectively performed with heterogeneous patient cohorts and often small sample sizes. Additionally, there were varying definitions of labor type and insurance status reported among articles. These factors increase the likelihood of bias introduction in the results of this study.

However, the large patient cohort included in this review provides greater statistical power, which may aid the validity of its conclusions. Additionally, as in all systematic reviews, there is the potential that relevant studies were not identified and included in this analysis. This risk was minimized through strict adherence to the PRISMA guidelines and thorough review of the reference lists for additional relevant studies.

In conclusion, the majority of injured workers undergoing rotator cuff repair return to previous work at approximately 8 months after surgery. Despite this, >35% of patients are unable to return to their previous work level after their repair procedure. Similar return-to-work rates can be anticipated regardless of workers' compensation status and operative technique, while patients in occupations of higher physical intensity experience inferior work outcomes.

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